

**SENSE ORGANS ON ANTENNAL FLAGELLUM OF
GYLLOBLATTA CAMPODEIFORMIS E.M. WALKER
(ORTHOPTERA: GRYLLOBLATTODEA)¹**

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ABSTRACT: Sense organs of five different types were found on the antennal flagellum of *Gylloblatta campodeiformis* E.M. Walker. They are tactile hairs, thick-walled chemoreceptors, thin-walled chemoreceptors, coeloconic chemoreceptors and campaniform sense organs.

DESCRIPTORS: sense organs, flagellum, insect, mechanoreceptors, chemoreceptors.

The relationship of *Gylloblatta campodeiformis* and of several closely-allied species to other insects has long been a matter of controversy (Kamp, 1973). By some systematists these are included with the Orthoptera as one of its families; by others they are considered to be a suborder of the Orthoptera and by still others they are placed in an order of their own. Consequently, any new anatomical information concerning the group should be of interest.

One antenna of a female specimen, that had been preserved in fluid, was sent to the writer by Dr. A.B. Gurney of the National Museum in Washington. It had been collected at Mt. Edith Cavell in Jasper Park, Alberta, Canada in September 1928 by N. Ford. The antenna was prepared as an unstained whole mount and the sense organs on it examined. Since no other antennae from this rare insect were available, the techniques ordinarily used for study — special staining, scanning and transmission electron microscopy — could not be employed. Interpretation of the results, however, was not difficult for all of the sense organs found were of types seen in earlier studies with other species of insects (Slifer, 1970).

The flagellum was 8 mm long and composed of 23 subsegments. Dr. Gurney has informed me that the other antenna has 26

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subsegments. In an earlier examination of 24 intact antennae Gurney (1953) found that the number ranged from 24 to 27. This coincides with the range reported by E.M. Walker (1914) for the two females on which the order is based. The subsegments are cylindrical (fig. 1). The basal subsegment is $260\ \mu$ long and the terminal one $277\ \mu$ but between these the subsegments varied from $135\ \mu$ (subsegment 3) to $423\ \mu$ (subsegment 12). The diameter of the first subsegment was $154\ \mu$ and that of the 23rd was $85\ \mu$.

The cuticle of the first subsegment is heavy and about $28\ \mu$ thick while that of the last is only $6\ \mu$. The number of sense organs per unit of surface increases distally. On the basal subsegment a mean distance between sense organs of $34\ \mu$ was found and on the 23rd a mean distance of $17\ \mu$. The distribution of sense organs on subsegment 10 is shown in fig. 1.

Five types of sensory receptors were identified — tactile hairs, thick-walled chemoreceptors, thin-walled chemoreceptors, coeloconic chemoreceptors and campaniform sense organs.

Tactile hairs are the most numerous of all the sense organs and are present on every subsegment. They have a tip so finely pointed

Fig. 1. Diagram of lateral surface of subsegment 10 of antennal flagellum of *Grylloblatta campodeiformis* to show distribution of sense organs. The sockets of the receptors, except the coeloconic, have been indicated by dots. Most of the structures are tactile hairs and thick-walled chemoreceptors. The nearly transparent, thin-walled chemoreceptors are difficult to see at this magnification and have been omitted, as have also the sockets at the extreme edges. The sense organ nearest the distal edge is the campaniform sense organ. Coeloconic sense organs have been indicated by crosses. X 260.

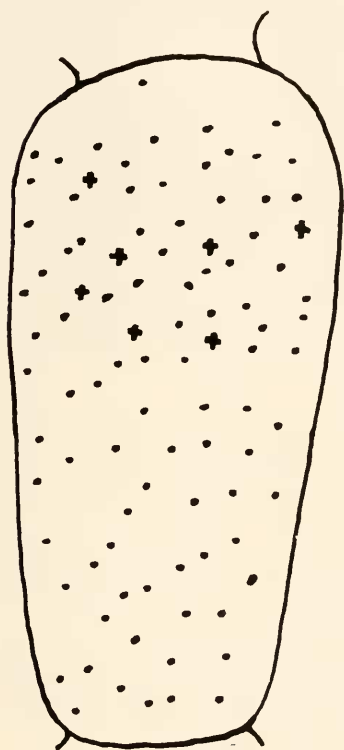
Fig. 2. Lateral view of tactile hair. Surface directed distad is at left. Note sharp tip. X 1000.

Fig. 3. Lateral view of thick-walled chemoreceptor. Surface directed distal is at left. Note rounded tip. X 1000.

Fig. 4. Lateral view of thin-walled chemoreceptor. Surface directed distad is at left. X 1000.

Fig. 5. Surface view of coeloconic chemoreceptor. Tip of peg is directed distad. X 1000.

Fig. 6. Campaniform sense organ from subsegment 1. Tip of projection is directed distad. X 1000.



1



2



3



4



5



6

that it is difficult to see where it ends with the oil immersion lens (fig. 2). The mean length of 25 that were measured was $68\ \mu$ (range 40 to $105\ \mu$). The longest tactile hairs are on the basal subsegments and the shortest towards the tip of the antenna.

Thick-walled chemoreceptors are present on all subsegments but are much less abundant than the tactile hairs. Superficially, they resemble the tactile hairs but the tip is definitely rounded (fig. 3) and the lumen more distinct. If a second antenna had been available it would have been treated externally with a dilute solution of crystal violet and the separation of the two types of hairs made easier since the stain enters the pore at the tip of a thick-walled chemoreceptor so treated while a tactile hair remains uncolored (Slifer, 1960). The mean length of 25 chemoreceptors measured was $70\ \mu$ (range 52 to $92\ \mu$). As do the tactile hairs, they decrease in length distally.

Thin-walled chemoreceptors occur on all subsegments. The cuticle is very thin and the tip broadly rounded (fig. 4). As is common in other insects, there is considerable variation in the ratio of width to length and also in the curvature of the structure. The mean length of 25 measured was $24\ \mu$ (range 15 to $39\ \mu$).

Coeloconic chemoreceptors were found on all subsegments except the first. Most are present on the lateral surface of the antenna. The maximum number found on a subsegment was 13 (22nd subsegment). On subsegments 1 through 8 the number present was 5 or fewer; all subsegments distal to 8 had 5 or more. These receptors have a peg, about $5\ \mu$ long, set in the floor of a cavity that is from 10 to $15\ \mu$ in diameter (fig. 5).

Campaniform sense organs are irregularly distributed on the flagellar subsegments. A total of 13 of these mechanoreceptors was found. There was one each on subsegments 1,2,4,6,8,10,11,13,14,15,16,18 and 20. These are situated at the distal margin on the subsegment on its lateral side and each is in line with similar structures on other subsegments proximal and distal to it. Those of the basal parts of the flagellum are largest and most conspicuous. They gradually decrease in size distally. Each consists of a flattened plate with a conical projection in its center (fig. 6). The plates measured had a diameter ranging from 7 to $11\ \mu$ and the projection was from 2.5 to $5\ \mu$ high. A cuticular

sheath extends inwards from the underside of the plate. In other insects this sheath has been found to contain a single dendrite that is attached to the under side of the plate.

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